Fundamental Mechanics: Quiz 12

6 December 2016

Name: Taylor Larrechea **Total:** 5 /5

Formulae: $\omega = \frac{d\theta}{dt}$ $\alpha = \frac{d\omega}{dt}$ $\tau = rF\sin\phi$ $\tau_{\text{net}} = I\alpha$ $L = I\omega$

$I = \sum_i m_i r_i^2$ (point masses) $I = MR^2$ (hoop) $I = \frac{1}{2}MR^2$ (disk)

$\vec{\mathbf{F}} = m\vec{\mathbf{a}}$ $F_{1 \text{ on } 2} = G\frac{m_1 m_2}{r^2}$ $G = 6.67 \times 10^{-11}\,\text{Nm}^2/\text{kg}^2$

A 16 kg disk with radius 0.50 m rotates counterclockwise about a frictionless axle (the axle is vertical) at a rate of 30 rad/s. A 12 kg lead brick is dropped vertically onto the disk and sticks at a point halfway from the axle to the edge of the disk. Determine the angular velocity of the disk after the brick sticks (assume that the brick is a point particle).

$L_i = L_f$ $L_i = I\omega_i$

$L_f = (I_T + I_B)\omega_f$

$\omega_f = \dfrac{L_i}{(I_T + I_B)}$

$\omega_f = \dfrac{60\ \text{rad/s} \cdot \text{kg}\cdot\text{m}^2}{(2\ \text{kg}\cdot\text{m}^2 + 0.75\ \text{kg}\cdot\text{m}^2)}$

$\omega_f = 21.82$ rad/s

$I = \frac{1}{2} m r^2$

$= \frac{1}{2}(16\ \text{kg})(0.50\ \text{m})^2$

$I = 2\ \text{kg}\cdot\text{m}^2$

$\omega_i = 30$ rad/s

$I_B = m r^2$ $r = 0.25$ m

$m = 12$ kg

$= (12\ \text{kg})(0.25\ \text{m})^2$

$I_B = 0.75\ \text{kg}\cdot\text{m}^2$